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## METHOD TO FABRICATE SHAPED LAMINATED GLASS PANES

This invention is directed to a method for  
5 manufacturing shaped laminated glass panes which comprise  
an intermediate layer (interlayer), such as a  
thermoplastic film, laminated between two shaped glass  
sheets. More particularly, at least one of the glass  
10 sheets is provided with a paint on a surface which is to  
bear against the intermediate layer.

Laminated glass windows of automotive vehicles, e.g.,  
windshields, often include an opaque border around the  
peripheral marginal surface of the windows. This  
obstruction band hides from external view the adhesive or  
15 any other securing means which lie behind the periphery of  
the windshield. These borders are generally ceramic  
enamel compositions formed from a mixture of metal or  
metal oxides and glass frit in a suitable organic vehicle.

In some situations, these borders are carried on the  
20 surface of the glass which is exposed inside the vehicle  
when the windshield has been provided on the vehicle. The  
paint which has been applied onto the unbent glass is  
fired onto that surface when the glass passes through the  
sag bending furnace as one of a pair of glass sheets which  
25 are sag bent together prior to lamination.

It has been more desirable, from a durability  
standpoint, to provide these borders on a surface of the  
glass sheet which will bear against the interlayer in the  
laminated product. In U.S. Patent 4,644,139 to Harrison  
30 et al., a process is disclosed for providing such a  
border. It involves sag bending the two glass sheets  
together with the eventual inner surface of the outer  
glass sheet carrying the opaque band being uppermost  
during the bending. After allowing the glass sheets to  
35 cool, a plastic interlayer is placed over the inner glass  
sheet and then the outer sheet is placed on the interlayer

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improved process for manufacturing such a windshield. It involves painting one of the windshield templates, and then, after drying the paint, pairing the templates with the painted side out. Subsequently, the pair is fired to prebend the pair to a partial shape and to fire the paint. The paint is then coated with a separating agent and the template pair reassembled with the painted side in. The reassembled pair is reloaded on a bending fixture and refired to complete the shaping process. The cooled pair is then washed free of the separating agent and laminated with an interlayer between. This process is elaborate and again requires a double firing of the glass with the increased likelihood of optical distortion.

EP-A 0 535 474 discloses a method for fabricating a shaped glass pane of laminated glass, the laminated glass comprising an inner glass sheet, an intermediate layer, and an outer glass sheet. The method comprises the steps of: providing a layer of paint on at least a portion of a glass sheet surface which is to bear against the intermediate layer; drying the paint at a temperature below the softening point of the glass; placing the outer and inner glass sheets together so that the glass sheet surfaces which are to bear against the intermediate layer are in proximity with one another and are parallel; bending the outer and inner sheets simultaneously into a final shape at an elevated temperature of at least about 550°C; cooling the outer and inner glass sheets; separating the inner and outer glass sheets; providing an intermediate layer between the outer and inner glass sheets; and laminating the outer and inner glass sheets with the interposed intermediate layer so as to form the pane of laminated glass.

In this method the paint is a screen-printable enamel paint comprising a glass frit powder, an inorganic pigment and optionally also an inorganic silicate binder, mixed

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Description of the Drawings

The invention will now be described further, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a schematic representation of a glass template having an  
5 opaque paint placed thereon;

Fig. 2 is a schematic representation, in end view, of two glass templates assembled one over the other prior to a glass bending operation; and

Fig. 3 is a schematic representation of the two glass templates of Fig. 2 after the bending operation has been completed.

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In accordance with the disclosure of the present invention, the following is presented as a description of a preferred embodiment of the method of making a shaped laminated pane of glass, like a windshield, having two sheets of glass with an interlayer between and a paint carried on at least a portion of the glass sheets which will bear against the interlayer. While the paint may be carried on a portion of one of the glass sheets, if desired it can be carried on both glass sheets, which will bear against the interlayer. While preferred materials are used to illustrate the method of the present invention, it does not mean that other materials within the scope of the claims cannot be used in the method.

A glass template 10 from a sheet of glass as is shown in Fig. 1. is provided with a layer of water-based silicate paint 12 around the peripheral portion. This glass template (or glass sheet) 10 is the template which will face the outside of the automotive vehicle when it is installed in the vehicle. Generally, this outer glass template is of larger size than the glass template which will face the interior of the vehicle (the inner glass template) when the outer and inner glass templates are laminated together by a laminating interlayer. The paint 12 is provided, according to one embodiment, on the surface of the first glass template 10 which will be in contact with the laminating interlayer when the glass template 10 is laminated to another glass template to form a laminated windshield. In the art, the surfaces of template 10 are commonly designated surface #1 and surface #2. Surface #1 is that which will be outermost when the windshield is installed in the vehicle and surface #2 is that which contacts the interlayer. While the paint may be provided on the outer glass template surface #2 as described above, it may alternatively or also be provided on the inner glass template on that surface (#3) which

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than about 1 minute in a microwave oven. As related to the time required to dry and cure the paint layer, the thickness of the paint layer is not critical. Optimal parameters for drying and curing the paint layer will be apparent to those skilled in the art in view of the present disclosure.

After the drying step, the paint is bonded to the selected surface of the glass template so that it could not be scratched off the glass if engaged by a tool or other scratching element. The bond is strong enough that the glass template may be handled and moved from one operation to another without damage to the painted opaque areas.

Reference is now made to Fig. 2. Next, according to the present method, a second glass template 14 (having surfaces #3 and #4) and the first glass template 10 are placed together, shown only in end-view in Fig. 2 and Fig. 3, so that the glass template surfaces (#2 and #3) which are to bear against the intermediate layer are in proximity with one another and are parallel. The second glass template 14 is generally shorter than the first glass template 10. Second glass template 14 will face inside the automotive vehicle when the windshield is installed in the vehicle. More particularly, surface #4 of the inner template of the installed windshield will be innermost to the vehicle interior. Subsequently the outer and inner templates are simultaneously bent into a final shape at an elevated temperature of at least 550°C, e.g., by any of the available processes for glass bending. Preferably the glass bending temperature is between 550°C and 650°C. One commonly used process involves a glass bending fixture 18 of Figs. 2 and 3. In such a process, bending of the glass template pair may be carried out by placing the pair 10, 14 on a bending fixture 16 as shown in Figs. 2 and 3. The fixture carrying the template pair

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operation to form a laminated glass windshield.

The following example is presented by way of description of the way of carrying out the method of the invention and to set forth a preferred embodiment contemplated by the inventors.

#### Examples

This is an example according to an embodiment of the present invention method. As disclosed above, in the art of windshield making the surfaces of the two templates used to make a windshield have been assigned #1 through #4 for their surfaces, progressing from #1 outside the vehicle to #4 inside the vehicle. A long and short template are cut from flat glass sheets. A black silicate paint (sodium silicate, copper oxide pigment, water and zinc oxide) is screen printed on the short templates on surface #3 around the periphery. The paint is dried at about 100°C using a microwave oven. The microwave oven does not heat the glass. The long and short templates are matched and assembled so that the paint is on the inside of the pair. The pair is loaded on a bending fixture and passed through a lehr and heated to about 575°C to bend the pair to the desired shape. After the pair is cooled, the templates are separated, washed, and dried.

A layer of polyvinyl butyral is provided between the two templates (surfaces #2 and #3) and the pair with interlayer is autoclaved at an elevated temperature of about 150°C and pressure of about 19.25 kg/cm<sup>2</sup> (275 lbs/in<sup>2</sup>) to bond the vinyl to the surfaces and form the laminated windshield.

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bending said outer and inner sheets simultaneously into a final shape at an elevated temperature of at least about 550°C.;

cooling said outer and inner glass sheets;

separating said outer and inner glass sheets;

providing an intermediate layer between said outer and inner glass sheets; and

laminating said outer and inner glass sheets with said interposed intermediate layer to form said pane of laminated glass.

3. A method according to claim 2 wherein the drying step is performed at a temperature below 400°C.

4. The method according to any one of claims 1 to 3, wherein said bending step is carried out using a glass bending fixture.

5. The method according to claim 4, wherein the glass bending fixture has a bending surface which corresponds to the final shape of the surface of the outer glass sheet.

6. The method according to any one of claims 1 to 5 wherein the glass pane is an automotive window, and the intermediate layer is a thermoplastic film.

7. The method according to claim 6, wherein said thermoplastic film is polyvinyl butyral.

8. The method according to claim 6, wherein the window is an automotive windshield or an automotive rear window.

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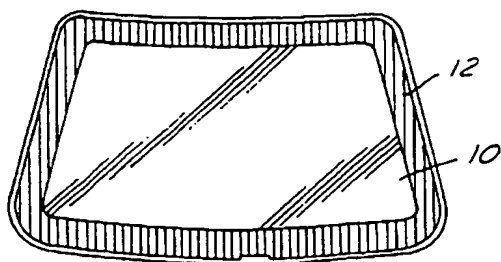


FIG. 1

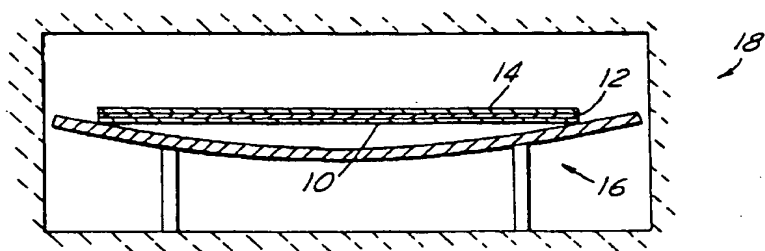


FIG. 2

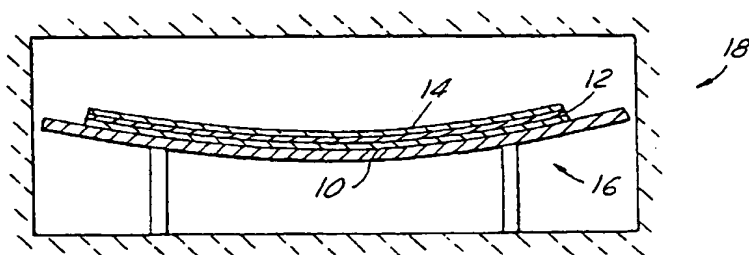


FIG. 3

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